Performance Assessment and Recommendations for Rejuvenation of a Permeable Reactive Barrier

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Permeable reactive barriers (PRBs) are engineered zones of reactive materials placed in an aquifer such that contaminants are removed from the groundwater as it flows through the reactive matrix. PRBs using granular zero-valent iron (ZVI) as the reactive media have been used since the early 1990s to treat trichloroethene (TCE) and other chlorinated solvents. Since about 1998, PRBs have also been used for the removal of radionuclides and metals. Many investigations of PRBs, including bench scale and column tests, have shown that ZVI corrosion causes mineral precipitation within the PRB that impedes performance and may significantly impact the design life and therefore the cost-effectiveness. Recent research by the U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (U.S. EPA) is evaluating the performance of PRBs for long-term application. Initial findings indicate that clogging may be a more significant issue than originally contemplated.

In June 2000, construction was completed on a PRB at a uranium milling site operated by Cotter Corporation in Canon City, CO. The PRB uses ZVI as the reactive media to mitigate contamination of molybdenum and uranium. The PRB, proposed in a 1999 CERCLA Record of Decision, was installed with the purpose of minimizing the flow of contaminated groundwater into the Lincoln Park subdivision that is located approximately one mile down-gradient from the mill. Within two years of construction, monitoring results indicated significant mounding at the up-gradient surface of the PRB and contaminant bypass of the barrier. The US EPA, U.S. DOE, Colorado Department of Public Health and Environment (CDPHE), and Cotter Corporation collectively decided to excavate the wall to determine what mechanisms had caused the PRB's failure and investigate whether the PRB could be rejuvenated.

Following the excavation and testing of the reactive media, recommendations for improving the efficiency of the Cotter PRB were developed. They include:
(1) Reconfiguring the PRB to allow accessibility so that the ZVI can either be maintained or changed out when necessary, (2) flushing the existing system with weak acids to restore hydraulic conductivity, and/or (3) installing a pretreatment zone consisting of coarse gravel mixed with ZVI that can lengthen the anticipate. The U.S. EPA and U.S. DOE believe the lessons learned will help in the future design of PRBs so that they can be easily monitored and maintained.